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### XIII. SOME TESTS BY THE ASSOCIATION REACTION METHOD OF MENTAL DIAGNOSIS

By HAZEL M. LEACH and M. F. WASHBURN

In the experiments whose results are discussed below we followed the method of Yerkes and Berry (this *Journal*, Vol. 20, page 22), with some slight modifications; our design being to test the method on as many observers as possible. Each observer was first given a practice series of twenty-five words, being told that on hearing a word she was to speak as quickly as possible the first associated word that occurred to her. The reaction times were taken with a stop-watch. The observer was then directed to go to another part of the laboratory and open one of two boxes that she would find there. On her return she was told that she must try by every possible means to keep the experimenter from learning into which box she had looked. Her reactions to a series of sixty words were then taken. In this series there were ten words referring to the contents of one of the boxes, and ten referring to those of the other box. These relevant words were scattered in among the others, but three or four words referring to the same object were given in immediate succession to increase their disturbing effect upon the observer. Twenty-six persons were tested, and all but one of these were observers in two experiments each, with different pairs of boxes. In one experiment, the objects in the boxes were a bottle of red ink and a watch; in the other, they were a toy snake and a rag doll. Later a pack of cards was substituted for the doll. The following were the stimulus words:

#### Series I. Ink bottle—watch.

- |               |               |                 |
|---------------|---------------|-----------------|
| 1. View.      | 21. Door.     | 41. Pond.       |
| 2. Bird.      | 22. Window.   | 42. Drama.      |
| 3. Lily.      | 23. Evening.  | 43. Church.     |
| 4. Satin.     | 24. Sugar.    | 44. Bottle.     |
| 5. Stitch.    | 25. Sharp.    | 45. Eraser.     |
| 6. Position.  | 26. Blotter.  | 46. Cork.       |
| 7. Walk.      | 27. Pen.      | 47. Indian.     |
| 8. Spring.    | 28. Glass.    | 48. Remark.     |
| 9. Tick.      | 29. Red.      | 49. Star.       |
| 10. Second.   | 30. Smile.    | 50. Clay.       |
| 11. Hands.    | 31. Heroine.  | 51. Doll.       |
| 12. Good.     | 32. Anthem.   | 52. Fish.       |
| 13. Indoors.  | 33. Columbus. | 53. Orange.     |
| 14. Nobody.   | 34. Shop.     | 54. Gold.       |
| 15. Sleep.    | 35. Lamp.     | 55. Fob.        |
| 16. Cow.      | 36. Time.     | 56. Mainspring. |
| 17. Carter's. | 37. Elgin.    | 57. Nails.      |
| 18. Fluid.    | 38. Hour.     | 58. Floor.      |
| 19. Write.    | 39. Boy.      | 59. Box.        |
| 20. Meat.     | 40. Castle.   | 60. Drink.      |

It will be seen that numbers 8, 9, 10, 11, 36, 37, 38, 54, 55, and 56 are the relevant words for 'watch'; while numbers 17, 18, 19, 26, 27, 28, 29, 44, 45, and 46 are the relevant words for 'red ink bottle.'

Series II. Snake—Doll (Cards).

1. House.	21. Finger (Dia-	41. Rattle.
2. Earthquake.	mond).	42. Train.
3. Sky.	22. Question (Joke).	43. Liberty.
4. Telepathy.	23. Net.	44. Sun.
5. Clue.	24. Horse.	45. Washington.
6. Tree.	25. Royal.	46. Law.
7. Radius.	26. Companion.	47. Pencil.
8. Boston.	27. Word.	48. Teddy Bear
9. Gray.	28. Disgrace.	(Play).
10. Crawl.	29. Nothing.	49. Stuffed (Spade).
11. Slimy.	30. Baby (Club).	50. Blue (Heart).
12. Bite.	31. Dress (Deal).	51. Lips (Question).
13. Study.	32. Calico (Card).	52. President.
14. Morning.	33. Fiction.	53. Salt.
15. Room.	34. Suffrage.	54. Tennis.
16. Comfort.	35. Shock.	55. Friendship.
17. Rain.	36. Home.	56. Ticket.
18. Apple.	37. Picture.	57. Adder.
19. Face (Bridge).	38. Wave.	58. Wriggle.
20. Red (King).	39. Coil.	59. Fang.
	40. Poison.	60. Servant.

The words in parentheses were used only in the experiments where the cards were substituted for the doll. Numbers 9, 10, 11, 12, 39, 40, 41, 57, 58, and 59 were relevant to 'snake'; numbers 19, 20, 21, 30, 31, 32, 48, 49, 50, and 51 to 'doll'; numbers 19, 20, 21, 22, 30, 31, 32, 48, 49, and 50 to 'cards.'

One of the authors of the paper, H. M. L., acted as experimenter throughout. The results did not come into the hands of the other author until after the entire series of experiments was finished and H. M. L. had recorded her judgments as to which box the observer had investigated in every case. H. M. L.'s decision was based partly on the average reaction times for the words referring to one object, as compared with the average reaction time for words referring to the other object; partly on the character of the associations. In one single experiment only, that is, one of the two series given to one of the observers, was this judgment incorrect. This means one error out of fifty-three experiments. *In all the experiments but four, the average reaction time for words referring to the object actually looked at was longer than that for the words referring to the other object.* One of these four cases was the case where H. M. L.'s judgment was incorrect; in the other three she judged correctly from the nature of the associations. It was noteworthy that the *shortest two average reaction times on the entire list were those for words referring to the object seen*, forming two of the four exceptions to the rule that the average reaction time to such words is long. H. M. L. concludes from this that in rare cases the dangerous words are reacted to with abnormal quickness. In both the instances here noted, the observers made no effort to prevent the significant words from suggesting the object seen, and the result was that such suggestions came more rapidly than the rest. *Yet in both these cases the longest single reaction time was that for a relevant word.* In all but six of the experiments, the mean variation for words referring to the object seen was longer than that for words referring to the other object; thus the reaction times

to relevant words seem usually, though not invariably, more irregular as well as longer than those for words referring to the other object.

When the results were turned over to M. F. W., it occurred to her that it would be interesting to see how far correct judgments could be based on the nature of the associations alone, leaving the times out of account altogether. She accordingly went over all the associations, with the times concealed, and tried to discover in each experiment which of the two objects had been seen by the observer. The aim of this was not so much to test the practicability of ignoring reaction times,—for there would be no advantage in leaving them out of account,—as to study the nature of the considerations that enable one to base a judgment on the character of the associations, a factor that always has to be taken into account. The total number of experimental results examined was fifty-two; in thirty-four of these a correct judgment was reached; in sixteen, a wrong judgment, and in two cases it was impossible to decide. The number of correct judgments that might be accounted for by chance was twenty-five. Evidently reaction-time alone is a much safer guide than the character of the associations alone.

What, now, are the peculiarities of the associations made which lead one to infer that a particular object has or has not been seen? After examining the associated words in each experiment, M. F. W. recorded her judgment and the reasons for it; and a careful study of these reasons seems to show that the types of self-betrayal fall into two classes according as the observer does or does not try to avoid significant associations. When there is *no effort to avoid*, we have, first, the cases where a *relevant stimulus word suggests a word that would not naturally occur to a person who had not seen the object*. This may be called the most naïve type; it would be the natural method of self-betrayal if there were no effort to conceal. It proved to be rare in these experiments, and to be an uncertain indication. Only one correct judgment was based upon it, where the word 'red' suggested 'ink,' as it would not have been very likely to do unless the red ink bottle had been seen. On the other hand, in two cases an incorrect judgment was reached on the same basis; once the object was wrongly judged to have been 'snake' because 'coil' suggested 'snake,' and another time it was judged to have been the ink bottle because 'fluid' suggested 'ink.' Needless to say, the judgments in both these cases were merely tentative; the unsatisfactory nature of the evidence was recognized, and it was influential only because no other basis for judgment presented itself. More convincing were the cases where a *relevant word gave an association different from that which would have occurred had the object to which the stimulus word referred been seen*. Thus in two cases correct judgments were reached because the stimulus word 'write' was perceived as 'right,' which would hardly have been the case had the ink bottle been seen. This form of self-betrayal is classed with the preceding because in neither case need there be any effort to conceal on the observer's part. Under this same head should come the cases where *the significant associations are given with abnormal frequency*. Thus in one series where the watch had been seen, the only reaction words given were 'watch' and 'time,' repeated again and again; in another case where the cards had been seen 'cards' was given five times as a reaction word, and in still another, where the object was the ink bottle, 'ink' was given six times. On the other hand this kind of evidence twice led to a wrong conclusion, 'snake' being given seven times and again five times when it was not the object seen. If this form of supposed self-betrayal could be relied upon, it would be because it indi-

cated a kind of recklessness in the observer's mind; a more disturbed condition than is suggested by the single occurrence of a significant association. The latter would happen to an observer who had no thought of concealment at all; the former, one might suppose, would be more likely to occur with one who had made up his mind that the best way to conceal would be to say whatever came into his head. However, the fact that such repetitions did occur with reference to an object that had not been seen at all, shows that it is unsafe to argue in this manner.

Over against these we may place the cases giving evidence of *forced avoidance of significant associations*. In eight instances a correct judgment was reached partly or wholly on the ground that not one of the relevant words suggested anything connected with the object to which it was intended to refer; that is, the avoidance of significant associations was *complete*. It was concluded that such avoidance must have been intentional. But there were two cases in which a wrong judgment was reached on this basis; not a single significant association occurred, and yet there was no intention to avoid, since the object to which the relevant words referred had not been seen at all. Then there were three correct judgments made on the basis of *avoidance* of a relevant association *under circumstances that would naturally have suggested it*: (1) after 'king' had suggested 'card,' 'diamond' suggested 'bracelet,' whereas it would in the mind of a person whose associations were normal have continued the 'card' train of ideas; (2) after 'tick' had suggested 'stop-watch,' 'second' suggested 'street;'; (3) after 'fob' had suggested 'watch fob,' 'main-spring' suggested 'Main Street.' Here again we have to offset these instances with a case of failure by the same method, but the mistake occurred where the application of the principle is by no means so clear as it was in the series just mentioned. After 'spade' suggested 'hearts,' 'heart' suggested 'feelings;'; it was wrongly concluded that the pack of cards had been seen, but the passage to a different line of associations here might have been due to the fact that the stimulus word 'heart' was a repetition of the last reaction word, so that the observer was not unnaturally given an impulse to break away from that set of ideas in a new direction. The effort to avoid significant associations shows itself also, as has often been pointed out, in the occurrence of *far-fetched* associations. The following is a list of the associations of this character upon which correct judgments were based: 'calico—variegated colors,' 'fang—boy,' 'second—how many in an hour,' 'time—big idea,' 'deal—what kind,' 'Elgin—make,' 'mainspring—mechanism,' 'tick—glasses,' 'second—tie,' 'time—guess,' 'slimy—dessert,' 'heart—chicken,' 'Elgin—Europe,' 'mainspring—lake,' 'tick—year,' 'mainspring—time,' 'hour—National Park.' In some series two or more of these 'forced' associations were found; altogether, eleven correct judgments were based wholly or partly upon them. They may not, as reported above, seem particularly far-fetched in every case, but they were always 'peculiar,' as compared with the other associations in the series. Three erroneous conclusions were formed on account of the occurrence of associations, at least as forced as any of those above, viz.: 'fang—fishes,' 'deal—page,' 'card—hardness' (the last two occurred in the same series), 'wriggle—little girl of that name.' Again, the effort to avoid is betrayed by the occurrence of *sound or rhyme associations*. These were found in the case of two observers only, and a correct conclusion was drawn in each case. One gave the following associations: 'tick—click,' 'time—last time,' 'hour—glower,' 'gold—golden;'; the object seen being the gold watch. The other observer, who had seen the snake, gave:

'crawl—sound of word,' 'wriggle—rig,' 'fang—hang.' Still another indication of an effort to avoid significant associations lies in *repeating the previous reaction word*. Thrice this betrayed the object seen: once when 'wriggle' and 'fang' both suggested 'lizard,' once when 'medicine' was suggested by both 'bottle' and 'cork,' and once when 'poison' and 'rattle' both suggested 'antidote.' In one series the observer took refuge in the word 'animal,' to conceal the fact that she had seen the snake; 'animal' was given in response to 'gray,' 'bite,' 'rattle,' and 'adder.' Once the *stimulus word itself*, 'hour,' was repeated, leading to the correct conclusion that the watch was the object seen. Finally, suspicion was aroused in one instance because the reaction word seemed to show a *reversion back to the preceding stimulus word*: 'tick' suggested 'watch' and the next word, 'second,' suggested 'ticking,' but the conclusion that the observer had seen the watch proved to be untrue.

It is thus evident how uncertain are the inferences based on the character of the associations alone. Judging from these results, the most trustworthy evidence is furnished by a misunderstanding of the stimulus word in a way that would be practically impossible for a person with the object to which it referred in mind, as when 'write,' which referred to the ink bottle, was heard 'right' and suggested 'wrong;' and by the occurrence of associations based on the sound of the word. Yet if 'write' had suggested 'wrong' only after an abnormally long interval, one might correctly infer that this was a forced association, so that it would be necessary to take account of the reaction time here also; while it may have been mere chance that the rhyming associations furnished the basis of none but correct judgments in these experiments of ours. There seems to be no *a priori* reason why undue emphasis on the sound of a word should always mean a desire to avoid associations connected with its meaning.

The best single criterion on which to base a decision as to the object seen by the observer in these experiments was the *longest single reaction time*. If, in each series, the longest reaction time was selected, and was found to be that of the reaction to a relevant word, this word proved in every case but two out of the fifty-three to refer to the object seen by the observer. If the longest time belonged to the reaction to an irrelevant word, the next longest was taken, and so on until one that was connected with a relevant word was reached. *The longest single reaction time to a relevant word proved, in every series but two, to be that of a reaction to a word referring to the object seen.* This record is better than that of the average reaction times; it will be remembered that there were four exceptions to the rule that these are longest for words connected with the object looked at. The exceptions to the rule of the longest single reaction time were among these four. In one of the exceptional series, the object seen was the pack of cards; the longest reaction time was for the association 'earthquake—Messina,' earthquake being an irrelevant word. Next longest was that for 'slimy—ooze,' 'slimy' referring to the snake, which had not been seen. Both of these delays might be accounted for by the emotional significance of the stimulus words. In the case of the other exception, the object looked at was the watch, but the longest single reaction time was that for 'Carter's—people,' in which the stimulus word referred to the ink-bottle. Here the delay was doubtless owing to the fact that a person who had not seen the ink-bottle would be somewhat puzzled by the unusual stimulus word 'Carter's.' There were eight cases where the longest single reaction time was that of the association with an irrelevant word, but where the longest

time of reaction to a relevant word was that of association with a word referring to the object seen. The irrelevant stimulus words that gave abnormally long reactions were as follows: (1) 'Position—too indefinite;' here the abstract character of the stimulus word seems to have caused the delay. (2) 'Clue—detective;' the next longest r. t. was that for 'bite—scratch.' These stimulus words probably had some affective accompaniment that caused the delay. (3) 'Remark—word;' here there is no discoverable reason for the long r. t., and the same is true of (4), 'house—brown,' and (5), 'walk—parachute.' If 'walk' had been a relevant word, the far-fetched character of this association together with the fact that its time was so long, would have led to the positive conviction that the object connected with 'walk' had been seen. Unfortunately the observer's introspection on this association was not recorded. In the case of (6), 'telepathy—man,' the unusual character of the stimulus word may again have been, at least in part, responsible for the delay; with (7), 'disgrace—prison,' affective influences undoubtedly played a part. In case (8), the longest three reaction times were to irrelevant words: 'comfort—vague idea;' 'servant—play;' 'disgrace—sin.' The last two involved affective elements (the observer had recently seen "The Servant in the House"); the first gave a slow reaction probably because of its abstract character. In general it may be said that when a word referring to an object not seen gives an abnormally long reaction time this is because it (a) is of a disturbing affective character in general, like 'disgrace;' (b) refers to some emotional complex, peculiar to the observer, or (c) is abstract or unusual in character. It would seem that the rule that the longest single reaction time to a relevant word is to a word associated with the object seen may be safely followed except where some word referring to the other object comes under one of the three classes just mentioned. One could never be sure of selecting all the relevant words in a series so that none should be connected with an emotional complex peculiar to the observer, but it would be possible to avoid using, as relevant words, those of general emotional import, or those which were unusual or abstract.